

WHAT IS CLAIMED IS:

1. A method of forming a VCSEL having a plurality of layers, comprising:

forming an ohmic contact adjacent an optical cavity;

5 forming a mesa in at least a portion of said plurality of VCSEL layers in accordance with said ohmic contact to expose an oxide aperture layer; and

oxidizing said oxide aperture layer to form an oxide aperture that is aligned with ohmic aperture formed by said  
10 ohmic contact.

2. The method of claim 1 further comprising forming a photoresist layer adjacent said ohmic aperture and a portion of said ohmic contact and wherein forming a mesa in  
15 at least a portion of said plurality of VCSEL layers comprises etching at least a portion of said plurality of VCSEL layers using exposed portion of said ohmic contact as an etch mask to define mesa sidewalls.

20 3. The method of claim 1 further comprising forming an upper mirror adjacent said ohmic contact and said optical cavity.

4. The method of claim 1 wherein said optical cavity  
25 comprises an active region comprising one or more active layers.

5. The method of claim 4 wherein said optical cavity further comprises a delta doped upper cladding and wherein  
30 said ohmic contact is formed adjacent said delta doped upper cladding to reduce contact resistance of said ohmic contact.

6. The method of claim 1 further comprising forming a dielectric spacer layer adjacent said optical cavity.

7. The method of claim 6 further comprising forming a multi-step photoresist adjacent said dielectric spacer layer and patterning said multi-step photoresist to define a via in said dielectric spacer layer for formation of said ohmic contact adjacent said optical cavity.

8. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;

forming an optical cavity over said lower mirror;

forming an oxide aperture layer over said optical cavity;

forming a p-type contact layer over said oxide aperture layer;

forming an annular ohmic contact pad on said p-type contact layer;

removing a plurality of layers of said VCSEL around said ohmic contact pad using an outer circumferential edge of said ohmic contact pad as a mask to form a circular mesa and thereby expose said oxide aperture layer at the mesa sidewall; and

oxidizing said oxide aperture layer inwardly from said mesa sidewall to form an annular oxide aperture that is self-aligned with said ohmic contact.

9. The method of claim 8 further comprising the step of forming an upper mirror structure over at least an inner portion of said ohmic contact to form a completed VCSEL structure.

5

10. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;

forming an optical cavity over said lower mirror;

10 forming an oxide aperture layer over said optical cavity;

forming a p-type contact layer over said oxide aperture layer;

15 forming a dielectric rephase layer over said p-type contact layer;

depositing a photoresist over said dielectric rephase layer;

20 patterning said photoresist to provide a circular puck of rephase material within said rephase layer and simultaneously define an annular via in said dielectric spacer layer;

forming an annular ohmic contact pad within said via, said ohmic contact pad being self-aligned with said puck of rephase material as a result of said patterning step;

25 removing said photoresist and said rephase layer outside said ohmic contact pad;

removing a plurality of layers of said VCSEL around said ohmic contact pad using an outer circumferential edge of said ohmic contact pad as a mask to form a circular mesa and thereby expose said oxide aperture layer at the mesa  
30 sidewall; and

oxidizing said oxide aperture layer inwardly from said mesa sidewall to form an annular oxide aperture that is self-aligned with said ohmic contact.

5        11. The method of claim 8 further comprising the step of forming an upper mirror structure over at least an inner portion of said ohmic contact to form a completed VCSEL structure.

10        12. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;

forming an n-type contact layer over said lower mirror;

15        forming an optical cavity over said lower mirror;

forming an oxide aperture layer over said optical cavity;

forming a p-type contact layer over said oxide aperture layer;

20        forming an annular ohmic contact pad on said p-type contact layer;

removing a plurality of layers of said VCSEL around said ohmic contact pad using an outer circumferential edge of said ohmic contact pad as a mask to form a circular mesa and to thereby expose said oxide aperture layer at the mesa sidewall, and to thereby further expose an upper surface of said n-type contact layer;

25

oxidizing said oxide aperture layer inwardly from said mesa sidewall to form an annular oxide aperture that is self-aligned with said ohmic contact; and

30

forming an ohmic contact pad on said exposed surface of said n-type contact layer.

13. The method of claim 12 further comprising the step of forming an upper mirror structure over at least an inner portion of said p-type ohmic contact to form a  
5 completed VCSEL structure.

14. The method of claim 12 wherein said lower mirror is an undoped mirror structure.

10 15. A method of forming a VCSEL having a plurality of layers, comprising:

forming a lower mirror on a substrate;

forming an n-type contact layer over said lower mirror;

15 forming an optical cavity over said lower mirror;

forming an oxide aperture layer over said optical cavity;

forming a p-type contact layer over said oxide aperture layer;

20 forming a dielectric rephase layer over said p-type contact layer;

depositing a photoresist over said dielectric rephase layer;

25 patterning said photoresist to provide a circular puck of rephase material within said rephase layer and simultaneously define an annular via in said dielectric spacer layer;

forming an annular ohmic contact pad within said via, said ohmic contact pad being self-aligned with said puck of  
30 rephase material as a result of said patterning step;

removing said photoresist and said rephase layer outside said ohmic contact pad;

removing a plurality of layers of said VCSEL around  
said ohmic contact pad using an outer circumferential edge  
of said ohmic contact pad as a mask to form a circular mesa  
and to thereby expose said oxide aperture layer at the mesa  
5 sidewall, and to thereby further expose an upper surface of  
said n-type contact layer;

oxidizing said oxide aperture layer inwardly from said  
mesa sidewall to form an annular oxide aperture that is  
self-aligned with said ohmic contact; and

10 forming an ohmic contact pad on said exposed surface  
of said n-type contact layer.

16. The method of claim 15 further comprising the  
step of forming an upper mirror structure over at least an  
15 inner portion of said p-type ohmic contact to form a  
completed VCSEL structure.

17. The method of claim 15 wherein said lower mirror  
is an undoped mirror structure.

20

25